SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

SEMESTER - V

CE3562–DESIGN OF REINFORCED CEMENT CONCRETE ELEMENTS

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SUBJECT NAME: DESIGN OF REINFORCED CEMENT CONCRETE ELEMENTS
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UNIT I - METHODS OF DESIGN OF CONCRETE STRUCTURES

Objective of structural design - Concept of reinforced concrete structures – Properties of Concrete and Reinforcing Steel - Different grades of concrete and steel used in RCC Load and loading standards as per IS:875 - Concept of Elastic method, ultimate load method and limit state method - Design of beams by working stress method.

PART-A

S.No.	Questions	BT Level	Competence
1	Define integrated structure.	BT-1	Remember
2	What are the different types of loads that have to be considered in the design of a building?	BT-1	Remember
3	Enlist the methods used for the design of RCC members.	BT-1	Remember
4	What is the formula used to find the critical neutral axis in working stress method?	BT-1	Remember
5	Give the values of partial safety factor for concrete and steel.	BT-1	Remember
6	What are the disadvantages of working stress method?	BT-1	Remember
7	Define modular ratio.	BT-1	Remember
8	Sketch the stress – strain curve of concrete.	BT-1	Remember
9	What is characteristic load and characteristic strength of a material?	BT-1	Remember
10	List the factors that affect the creep of concrete.	BT-2	Understand
11	Write the formula for the neutral axis depth factor 'K in working stress design.	BT-2	Understand
12	State the main concept of elastic method or working stress method.	BT-2	Understand
13	What is permissible bending stress in concrete?	BT-2	Understand
14	Write down the advantages of limit state method over other methods.	BT-1	Remember
15	What are the expressions recommended by the IS 456-2000 for Modulus of Elasticity and Flexural Strength of concrete?	BT-1	Remember
16	Examine the assumptions made in limit state of collapse by flexure.	BT-2	Understand
17	Write about cover of concrete.	BT-2	Understand
18	Distinguish between under reinforced and over reinforced sections.	BT-2	Understand
19	Differentiate WSM from LSM.	BT-2	Understand
20	Order the various Limit state as per IS 456 – 2000.	BT-2	Understand

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21	Justify why limit LSM is preferred over WSM?	BT-1	Remember
22	Solve the modular ratio for M20, M30 grade of concrete.	BT-1	Remember
23	Express the relation between flexural strength (f_{cr}) and characteristic compression strength f_{ck} of concrete.	BT-2	Understand
24	What are the classifications available in serviceability limit state?	BT-1	Remember

PART-B

1	Discuss the terms of (a) Neutral axis (b) Moment of resistance (c) Lever Arm (d) Modular Ratio	BT-3	Application
2	Explain the properties on concrete in detail.	BT-3	Application
3	a) Give the load combinations in LSM as per IS standard. b) Discuss the various properties of reinforcing steel.	BT-3	Application
4	Discuss about various RCC sections.	BT-3	Application
5	a. What are the main loads, forces and effects to be considered while designing the structures? b. What is the shape of the design stress-strain curve for concrete under compression? c. Distinguish between singly and doubly reinforced concrete beams.	BT-3	Application
6	Compare and Contrast LSM, ULM and WSM.	BT-3	Application
7	Derive an expression for the depth of neutral axis, MOR for a rectangular singly reinforced balanced beam section under flexure and obtain the design constants k, j, Q for M20 grade of concrete and FE 415 grade of steel using working stress method.	BT-2	Understand
8	a. Calculate moment of resistance of a RCC beam of size 400 x 650 mm is reinforced with 4 bars of 20 mm M30 and Fe 415 grade of concrete and reinforcement, respectively is used. b. Determine the moment of resistance of a singly reinforced beam 160X300mm effective section, if the stress in steel and concrete are not to exceed 140N/mm^2 and 5N/mm^2.effectve span of the beam is 5m and the beam carries 4 nos of 16mm diameter bars. Take m=18.find also the minimum load the bam can carry. Use WSD	BT-3	Application
9	a. A singly reinforced beam 230 mm wide and 350 mm effective depth is reinforced with 3 nos of 12 mm diameter bars. Determine the moment of resistance of the section. Use M 20 and Fe 250 (mild steel) grade of materials. b. What is the load carrying capacity if it is used as simply supported beam over a span of 3m.		
10	Design a beam section to resist the maximum bending moment in a SSB of span 5m (inclusive of self-weight) using M20 and Fe415 grade of steel using WSM method.	BT-4	Analyze

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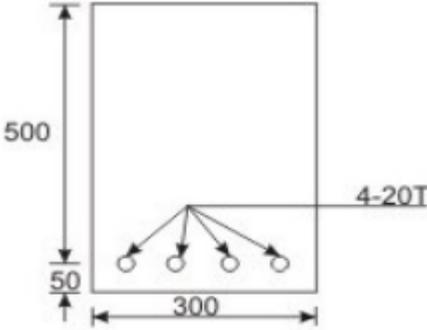| 11	A singly reinforced beam 250 mm wide and 380 mm deep to the centre of reinforcement is reinforced with 3 nos of 18 mm diameter bars. Determine the depth of N.A and maximum stress in concrete when the stress in steel is 150 N/mm^2. Take m = 13.33	BT-4	Analyze
12	a) The cross section of a singly reinforced concrete beam is 300 mm X 400 mm. This is reinforced with #3 – 12 mm diameter bars. Determine the M.R if stresses in steel and concrete are not to exceed 230 N/mm^2 & 7 N/mm^2 respectively. b) The cross section of a singly reinforced concrete beam is 300 mm X 450 mm. This is reinforced with #4 – 16 mm diameter bars. Determine the M.R if stresses in steel and concrete are not to exceed 230 N/mm^2 & 7 N/mm^2 respectively.	BT-4	Analyze
13	A singly reinforced rectangular beam of 300 mm wide and effective depth as 500 mm with the span of 6.25 m. This carries an all-inclusive load of 16 kN/m. Determine stresses in steel and concrete respectively.	BT-4	Analyze
14	A rectangular simply supported beam of width 350 mm is subjected to a uniformly distributed load of 15 kN /m over an effective span of 8 m Determine the depth required for the beam and also calculate the area of tensile reinforcement required Use M 20 and Fe 250 grade of concrete and reinforcement, respectively.	BT-4	Analyze
15	Design a R.C beam to carry a load of 6 kN/m inclusive of its own weight on an effect span of 6m keep the breath to be 2/3 rd of the effective depth .The permissible stresses in the concrete and steel are not to exceed 5N/mm^2 and 140 N/mm^2. Take m=18.	BT-5	Evaluate
16	Design a beam subjected to a bending moment of 40kNm by working stress design. Adopt width of beam equal to half the effective depth. Assume the permissible stresses in the concrete and steel are not to exceed 5N/mm^2 and 140 N/mm^2. Take m=18	BT-3	Evaluate
17	Determine the moment of resistance of a singly reinforced beam 160 mm X 300mm effective section, if the stress in steel and concrete are not to exceed 140N/mm^2 and 5N/mm^2.effectve span of the beam is 5m and the beam carries 4 nos of 16mm diameter bars. Take m=18. Find also the minimum load the bam can carry. Use WSD method.	BT-4	Analyze
18	Design a doubly reinforced beam of section 240X500mm to carry a bending moment of 80kNm.Assume clear cover at top a bottom as 30mm and take m=18.adopt working stress method. Assume the permissible stressed in the concrete and steel are not to exceed 5N/mm^2 and 140 N/mm^2 .		

UNIT II – LIMIT STATE DESIGN OF BEAMS

Analysis and design of singly and doubly reinforced rectangular and flanged beams– Use of IS codes and design aids for Flexure - Behaviour of rectangular RC beams in bond, anchorage, shear and torsion - Design of RC members for combined Bending, Shear and Torsion .

PART-A

Q. No.	Questions	BT Level	Competence
1.	Sketch the stress block diagram of concrete.	BT-2	Understand
2.	Sketch the stress distribution of an RC singly reinforced beam of rectangular section.	BT-2	Understand
3.	Write down the value of design bond stress for M 20 & M 30 grade concrete.	BT-1	Remember
4.	Recall the term anchorage.	BT-1	Remember
5.	On what circumstances doubly reinforced beams are to be adopted?	BT-1	Remember
6.	Argue that concrete is good in compression not in tension?	BT-1	Remember
7.	Enlist the advantages of flanged beams.	BT-2	Understand
8.	What do you mean by reinforcement in RC structures?	BT-1	Remember
9.	Differentiate flexural bond and anchorage bond.	BT-2	Understand
10.	Differentiate between design mix and nominal mix concrete.	BT-2	Understand
11.	Identify the reason why steel is most preferred as a reinforcement material over other material?	BT-1	Remember
12.	Prescribe the loading conditions and age of structure for conducting load tests.	BT-1	Remember
13.	What do you mean by bond?	BT-1	Remember
14.	Discuss about the distribution of torsional reinforcement as per IS 456:2000.	BT-2	Understand
15.	Enlist the concrete grade that can be used for reinforced concrete work.	BT-1	Remember
16.	Differentiate shear failure and bending failure.	BT-2	Understand
17.	Define development length.	BT-1	Remember
18.	Show the difference between under reinforcement and over reinforcement section.	BT-2	Understand
19.	How to overcome torsion on beams?	BT-1	Remember
20.	Quote the minimum and maximum reinforcement as per IS 456 : 2000.	BT-1	Remember
21.	Enlist the types of shear failure in reinforced concrete beams?	BT-1	Rememeber
22.	Write the formula for effective flange width of isolated L-beam and T-beam?	BT-1	Remember
23.	Classify LS of flexure.	BT-1	Remember
24.	What are the basic assumptions in the design of flexural members for the limit state of collapse?	BT-1	Remember

PART-B

1.	A Singly reinforced beam 200 mm wide is 400 mm deep to the centre of tensile reinforcement. Determine the limiting moment of resistance of the beam section and limiting area of reinforcement. Use M 20 and Fe 250 grade of materials.	BT-3	Understand
2.	Determine the ultimate MOR of rectangular RC beam having a width of 350 mm and effective depth of 700 mm is reinforced with #2 -28mm and #2-25mm. Use concrete grade M20 and steel grade Fe415.	BT-4	Analyze
3.	a. Find the target mean compressive strength of M20 grade concrete (assume standard deviation as per IS 456:2000) b. What is the modulus of elasticity of concrete having mean target strength 40 MPa as per IS 456:2000? c. What is the flexural tensile strength of concrete having cylinder compressive strength 50 MPa (As per IS 456:2000)? d. What is the split tensile strength of the concrete having cylinder compressive strength of 40 MPa?	BT-4	Analyze
4.	Design a beam of effective span 6 m to support a total working load of 12 kN/m including the self-weight of the beam by LSM. The width of the beam is limited to 250 mm. Use M 20 concrete and Fe 415 steel.	BT-4	Analyze
5.	Design the singly reinforced concrete beam to suit the following data: Clear Span = 4 m Width of supports = 300 mm Service load = 5 kN/m Grade of concrete = M 20 Grade of steel = Fe 415 HYSD bars	BT-3	Understand
6.	The rectangular beam of width, 300 mm is having overall depth of 600 mm. The concrete grade is M20 and the grade of reinforcing steel is Fe415. The tensile reinforcement is provided by 4-20 mm bars. In the compression side, the reinforcement is provided by 2-16 mm bars. The effective cover is 50 mm at top and bottom. Determine the moment capacity of the section due to concrete as per limit state method.	BT-3	Understand
7.	An RCC beam having size 250 mm X 400 mm (Overall) is reinforced with 4 bars of 20 mm diameter bars in the tension zone. Determine a) Ultimate MR using M 20 and Fe 415 grade of materials b) Safe load carrying capacity if the effective span is 6 m.	BT-4	Analyze
8.	Design a doubly reinforced concrete beam of rectangular section using the following data: Effective span=5m Width of beam=250mm Over all data=500mm Service load (DL+LL) =40 kN/m. Effective cover=50mm M20 grade of concrete and Fe415 HYSD bars	BT-4	Analyze
9.	Calculate the moment of resistance of a T beam having a flange width 850 mm, web width 275 mm, flange thickness 100 mm and an effective depth 475 mm.	BT-4	Analyze

	the beam is reinforced with 4 bars of 20 mm diameter on tension side. Use concrete grade M20 and steel grade Fe415.		
10.	A T-beam of flange width 1200 mm, flange thickness 100 mm, rid width 275 mm has an effective depth of 550 mm and is reinforced with 6 bars of 25 mm diameter and 4 bars of 16 mm diameter. Find the ultimate moment of resistance. Use M 20 grade of concrete and Fe 415 grade of steel bars.	BT-3	Application
11.	A T-beam of flange width 1500 mm, flange thickness 120 mm, rid width 300 mm has an effective depth of 560 mm and is reinforced with 5 bars of 25 mm diameter. Find the ultimate moment of resistance. Use M 20 grade of concrete and Fe 415 grade of steel bars.	BT-4	Analyze
12.	Design a T beam having a flange width 750 mm, web width 250 mm, flange thickness 90 mm and an effective depth 500 mm. the beam is applied with the moment (factored) of 130 kN.m. Use concrete grade M20 and steel grade Fe415.	BT-4	Analyze
13.	Check the development length at support of a doubly reinforced 400 mm × 750 mm (effective) size beam, the clear span of the beam is 5.25 m. The beam carries UDL of 46 kN/m (including self weight). The beam is reinforced with 8 bars of 20 mm diameter (4 are bent up near support) on tension side and 4 bars of 16 mm diameter on compression side. Adopt M20 grade concrete and Fe415 HYSD bars.	BT-4	Analyze
14.	A rectangular beam with b = 350 mm and d = 550 mm has a factored shear of 400 kN at the critical section near the support. The steel at the tension side of the section consists of four 32 mm dia. bars which are continued to support. Design the vertical stirrups for the section. Use Limit State Method. Adopt M20 grade concrete and Fe415 HYSD bars.	BT-4	Analyze
15.	Design a shear reinforcement for a simply supported beam of effective span = 8 m subjected to superimposed live load of 35 kN/m. The gross section of the beam = 300 × 700 mm. Percentage of steel = 1.22%. Use M20 and Fe415 steel.	BT-4	Analyze
16.	Determine the anchorage length of 4-20T reinforcing bars going into the support of the simply supported beam shown in Fig. The factored shear force Vu = 280 kN, width of the column support = 300 mm. Use M 20 concrete and Fe 415 steel. 500 4-20T 50 300	BT-3	Application
17.	a) Distinguish between lap length and development length. b) Tabulate the design bond values for various concrete mixes. c) Sketch the reinforcement details on anchorage of stirrups.	BT-3	Application
18	Design the reinforcement required for a rectangular beam section for the following data. Size of the beam : 500 mm X700 mm		

	Concrete Mix : M 15 Steel grade : Fe 415 Factored moment : 130 kNm Factored torsion : 10 kNm Factored Shear : 130 kN		

UNIT III   DESIGN OF SLABS AND STAIRCASES

Analysis and design of Cantilever - one way - two way - continuous slabs for various boundary conditions. Staircases - Types of Staircases - Design of staircases (ordinary and doglegged).

PART A

1	List the types of slab.	BT-1	Remember
2	What are the rules to be followed in the design of slabs as per IS 456-2000?	BT-1	Remember
3	Why is secondary/distribution reinforcement provided in RC slab?	BT-1	Remember
4	Why corner reinforcement is provided in a two way slab?	BT-1	Remember
5	Brief about the torsional reinforcement.	BT-1	Remember
6	List the advantages of cantilever slab.	BT-1	Remember
7	Sketch the load distribution of one-way and two-way slab.	BT-2	Understand
8	Distinguish between one-way and two-way slab.	BT-2	Understand
9	Enlist the serviceability requirement for one-way slab.	BT-1	Remember
10	Outline the codal provisions for minimum reinforcement to be provided main and secondary reinforcement in slab and their spacing.	BT-1	Remember
11	Sketch the typical reinforcement detailing of one-way slab.	BT-2	Understand
12	In what way, the deflection limit differed for two-way slab as per IS 456-2000?	BT-1	Remember
13	Give the formula for maximum bending moments per unit width in a slab.	BT-1	Remember
14	Give the condition for reinforcement in two-way slab for continuous edge and discontinuous edge.	BT-1	Remember
15	When cantilever slab are provided?	BT-1	Remember
16	Distinguish between transverse span and longitudinal span stair case.	BT-2	Understand
17	Sketch a typical stair case and mention the basic nomenclature.	BT-2	Understand
18	Sketch the typical reinforcement detailing of any one stair case.	BT-2	Understand
19	Write down the different types of staircase.	BT-1	Remember
20	Recall tread and rise.	BT-1	Remember
21	Tell about Flight and Going.	BT-1	Remember
22	What is the minimum rise and tread in residential and public buildings?	BT-1	Remember
23	Identify the circumstances under which dog- legged staircases can be used.	BT-1	Remember
24	Sketch the plan of various stair cases.	BT-2	Understand

PART B

1	a) Discuss about various types of slabs b) Sketch the load transfer mechanism in slab	BT-3	Application
2	Distinguish between one-way and two-way slab in detail.	BT-3	Application

3	Design a cantilever balcony slab projecting 1 m from a beam. Adopt live load of 3 KN/m^2. Adopt M-20 grade concrete and Fe 415 HYSD bars.	BT-3	Application
4	Design a one-way slab with a clear span of 3.5 m, simply supported on 200 mm thick concrete masonry walls to support a live load of 4 kN/m^2. Adopt M-20 grade concrete and Fe 415 HYSD bars.	BT-4	Analyze
5	Design a RC roof slab for the following details. Live load = 2 kN/m^2 Dimensions of room = 3.3 m X 7.5 m Width of support = 230 mm Edges are simply supported M20 & Fe 415 grade of materials.	BT-4	Analyze
6	A residential building floor slab of 130 mm thick with steel rods of 10 mm at 100 mm c/c. The effective span of the slab is 3m. Find the safe UDL it can carry including its self-weight. Take the grade of materials as M 25 & Fe 415. The slab is simply supported on all four sides.	BT-4	Analyze
7	Design the concrete slab to carry a live load of 3 kN/m^2. The slab is supported on all four sides. The slab is supported on brick wall of 230 mm thick and the slab thickness is 130 mm. Inside dimension of room is 3m X 7m. Use M20 and Fe 415 grade of materials.	BT-4	Analyze
8	Design the one-way continuous slab of Fig. subjected to uniformly distributed imposed loads of 5 kN/m^2 using M 20 and Fe 415. The load of floor finish is 1 kN/m^2. The span dimensions shown in the figure are effective spans. The width of beams at the support = 300 mm. 	BT-4	Analyze
9	Design the R.C Slab for a room size 3.5 m X 3.5 m. The slab is simply supported on all four edges. With corners are not held down, the slab carries a live load of 3.5kN/m^2 and width of wall is 230 mm. Adopt M-20 grade concrete and Fe 415 HYSD bars. Use IS code method.	BT-4	Analyze
10	Design the roof slab of a hall having the size of 3m X 4.7 m. Slab is simply supported on 4 edges and free to lift at corners. The width of the bearing is 230 mm. Live load on the slab is 1.5kN/m^2. Adopt M-20 grade concrete and Fe 415 HYSD bars.	BT-4	Analyze
11	Design a one way slab for an office floor which is continuous over T-beam spaced at 3.5 m intervals. Assume live load as 4 kN/m^2. Adopt M-20 grade concrete and Fe 415 HYSD bars.	BT-4	Analyze
12	Design a continuous one way having 3 equal span of 3m each having imposed load of 2.5 kN/m^2.Use Fe 415 & M15.	BT-4	Analyze
13	Design the cantilever panel of one-way slab of Fig. subjected to uniformly distributed imposed loads of 5 kN/m^2 using M 20 and Fe 415. The load of floor	BT-3	Application

finish is 0.75 kN/m^2. The span dimensions shown in the figure are effective spans. The width of beams at the support = 300 mm.

14	Design one of the flight of a dog-legged stairs spanning between landing beams using following data Number of steps in a flight = 10 Tread = 300 mm Rise = 150mm Width of landing beams = 300mm	BT-3	Application
15	Discuss about various types of stairs.	BT-3	Application
16	Design a stair for a residential building having floor height of 3.30 m. Take LL = 3kN/m^2, M20 and Fe 415. The landing slabs are supported by walls at its ends.	BT-4	Analyze
17	Sketch a typical dog-legged stair case and recall all the technical terms and its components.	BT-3	Application
18	Write the design procedure of a two-way slab with reinforcement detailing as per IS 456 – 2000.		

UNIT IV - LIMIT STATE DESIGN OF COLUMNS

Types of columns – Braced and unbraced columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending - Design of Slender columns using SP-16.

PART-A

Q. No.	Questions	BT Level	Competence
1	Define Column.	BT-1	Remember
2	Sketch a typical column interaction diagram showing the salient points.	BT-2	Understand
3	Distinguish between long column and short column.	BT-2	Understand
4	Give the various types of columns.	BT-1	Remember
5	According to IS code "All the columns shall be designed for minimum eccentricity". Justify the reasons for this statement.	BT-1	Remember

6	What are the specifications for pitch of lateral ties in columns?	BT-1	Remember
7	What is slender column?	BT-1	Remember
8	Mention the functions of the traverse reinforcement in a RC column.	BT-1	Remember
9	Give the specifications for diameter of lateral ties in column.	BT-1	Remember
10	Enlist the function of lateral ties in a RC column.	BT-1	Remember
11	What are the factors involved in load carrying capacity of column?	BT-1	Remember
12	Write down the expression for minimum eccentricity.	BT-1	Remember
13	Define slenderness ratio.	BT-1	Remember
14	Differentiate between braced and unbraced column.	BT-2	Understand
15	What are the specifications for pitch of lateral ties in spiral columns?	BT-1	Remember
16	Differentiate between uniaxial and biaxial bending.	BT-2	Understand
17	Write down the formula for ultimate load carrying capacity of a short axially loaded column.	BT-1	Remember
18	Sketch the typical reinforcement for any two column sections.	BT-2	Understand
19	Differentiate single and double curvature in a column.	BT-2	Understand
20	Give the specifications for helical reinforcement.	BT-1	Remember
21	Give the requirements for longitudinal reinforcement of column.	BT-1	Remember
22	Write the expression for load carrying capacity of column.	BT-1	Remember
23	Define pedestal. d of 2000 kN. Use M20 grade concrete and Fe415 grade steel.	BT-1	Remember
24	Name the failure modes of column.	BT-1	Remember

PART –B

1	Design the reinforcement in short column 300 mm x 600 mm subjected to an ultimate axial load of 2000 kN. Use M20 grade concrete and Fe415 grade steel.	BT-4	Analyze
2	Design the reinforcement in a circular column of diameter 300mm to support a factored load of 800kN. The column has an unsupported length of 3 m and is braced against side sway. The column is reinforced with helical ties. Adopt M20 grade concrete and Fe415 steel bars.	BT-4	Analyze
3	Design the reinforcement in short column 300 X 500 mm subjected to an ultimate axial load of 500kN together with factored moment of 200kNm. Use M20 grade concrete and Fe415 grade steel.	BT-4	Analyze
4	Design the reinforcement in a circular column of diameter 400mm to support a factored load of 800kN and factored moment of 80kN.m The column is reinforced with helical ties. Adopt M20 grade concrete and Fe415 steel bars.	BT-4	Analyze

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5	Design the column of height 3m and service load of 1650kN and size 380 mm x 500 mm. The end conditions are one end fixed and other end hinged. Use M25 and Fe 415.	BT-4	Analyze
6	Design a braced column subjected to a factored load P_u = 1860kN, M_{ux} = 80kN.m, M_{uy} = 60kN.m. The size of the column is 300 mm x 600 mm and unsupported length is 4m. Use M20 and Fe415. Reinforcement distributed equally on four sides.	BT-3	Application
7	Find the cross - section of a square column and reinforcement for axially loaded column for following data: Working load = 1800 kN, Grade of concrete M25 and Steel Fe 415, Unsupported length = 3500mm, Both ends are hinged.	BT-3	Application
8	Calculate the cross - section required and reinforcements for the following data, P_u = 1900kN, unsupported length = 3m, grade of concrete M20, and steel Fe 415, one end fixed and other hinged.	BT-4	Analyze
9	Design a short circular column with helical reinforcement to carry an ultimate load of 1200kN at an eccentricity of 150mm. Use M20 and Fe415 diameter of column is 500mm.	BT-5	Evaluate
10	Design a short circular column with circular tie of 450mm dia. subjected by a factored load of 1150 kN and factored moment of 87 kN.m. Use M20 and Fe415.	BT-5	Evaluate
11	Design a short square column of size 300 mm x 300 mm to carry an ultimate load of 750kN and an eccentricity of 68 mm. Use M20 and Fe 415.	BT-5	Evaluate
12	A short column of 300 mm x 380 mm is reinforced with 6 # 16 mm diameter on two sides. find the value of M_u, if it is subjected by the ultimate load of 675 kN. Use M20 and Fe415.	BT-3	Application
13	Determine the M_u for short column 300 mm x 600 mm which is reinforced with 8 # 20 mm diameter on two sides. Use M25 and Fe415. The factored load is 1650kN.	BT-3	Application
14	Deduce the P_u for short column of 450 mm x 450 mm which is reinforced with 8 # 16 ϕ and subjected to ultimate moment of M_u = 70 kN.m. Use M25 and Fe415.	BT-4	Analyze
15	Check the adequacy of the short column having the cross section of 300 x 450 mm. P_u = 1200kN, M_{ux} = 38N.m M_{uy} = 62kN.m. Longitudinal reinforcement 4 # 16 ϕ + 4 # 20 ϕ and transverse reinforcement 8mm ϕ at 150mm centre to centre. Use M20 and Fe 415.	BT-4	Analyze
16	Determine the reinforcement to be provide in a short column subjected to biaxial bending with the following data: Size of column = 45cm x 60cm Concrete mix = M25 Characteristic steel strength = 500MP$_a$ Factored load P_u = 3300kN Factored moment acting parallel to larger dimension M_{ux} = 150kN.m Factored moment acting parallel to smaller dimension M_{uy} = 100kN.m Moments due to minimum eccentricity are less than the value given above. Reinforcement is distributed equally on four sides.	BT-4	Analyze
17	Discuss about various types of column in detail with neat sketch and Sketch the typical reinforcement for various column sections	BT-3	Application
18	Deduce the ultimate load the column can carry having 6# 16 mm diameter bars		

| | and diameter of column is 380 mm. Both ends held in position and restrained against rotation. Unsupported length = 3m. Find the ultimate load for the following conditions
a)　　Circular tie column
b)　　Spiral tie of 8 mm @ 75 mm pitch | | |

UNIT V - LIMIT STATE DESIGN OF FOOTINGS

Concept of column footing - Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular and sloped footings – Design of Combined Rectangular and Trapezoidal footing for two columns - Principles of design of mat foundation.

PART – A

Q. No.	Questions	BT Level	Competence
1.	What are the factors that influence the selection of number of lifting and hoisting locations of a long beam during its erection process?	BT-1	Remember
2.	Define punching shear.	BT-1	Remember
3.	Brief the concept of proportioning of footing.	BT-1	Remember
4.	When you need a combined footing?	BT-1	Remember
5.	What is the major role of foundation?	BT-1	Remember
6.	What do you mean by eccentric footing?	BT-1	Remember
7.	Classify the different types of combined footing.	BT-2	Understand
8.	Enlist the different condition for usage of footing.	BT-1	Remember
9.	Discuss about Pad footing.	BT-3	Application
10.	What are the factors governing to decide the depth of footing?	BT-1	Remember
11.	On what circumstances combined rectangular footings are suitable?	BT-1	Remember
12.	Draw a neat sketch of a wall footing.	BT-2	Understand
13.	Sketch the placement of steel in rectangular footing with a non-central load.	BT-2	Understand
14.	Sketch the reinforcement detailing of any one footing.	BT-2	Understand
15.	Draw the cross section of strip footing.	BT-2	Understand
16.	What is the purpose of providing of foundation?	BT-1	Remember
17.	Explain about eccentric loading on a footing.	BT-3	Application
18.	Why punching shear is not encouraged in design of footing?	BT-1	Remember

19.	Why dowel bars are provided in footing?	BT-1	Remember
20.	List any two situations in which combined footings are preferred to isolated footings	BT-1	Remember
21.	Under what the circumstances a trapezoidal footing becomes necessary?	BT-1	Remember
22.	How is the main steel distributed in wall footings and two way rectangular footings?	BT-1	Remember
23.	List out the different types of footing.	BT-1	Remember
24.	Compare one way and two way shear in footing.	BT-2	Understand

PART –B

1.	Design a RC footing for 350 mm thick brick masonry wall which support a load of 260 kN/m if the SBC of the soil is 150kN/m^2. Use M20 and Fe415.	BT-4	Analyze
2.	Design a RC footing for the RC wall of thickness 300 mm carrying a load of 580 kN/m SBC of soil is 185kN/m^2. Use M20 and Fe415.	BT-4	Analyze
3.	Write the design procedure for Isolated footing.	BT-3	Application
1.	Write the step by step design procedure for circular footing.	BT-3	Application
2.	Write the step by step design procedure for square footing.	BT-3	Application
3.	Design a square footing of uniform thickness for RC column carrying 720 kN and having base of size 300 mm x 300 mm. the safe bearing capacity of soil is 175 kN/m^2. Use M20 and Fe 415.	BT-4	Analyze
4.	Design a RC isolated footing for a column of size 450 mm X 450 mm transmitting a load of 985 kN and uniaxial bending moment of 49.25 kN.m. The SBC of soil 210 kN/m^2, Use M20 and Fe 415. Design unsymmetrical RC footing.	BT-4	Analyze
5.	A column of size 450 mm x 450 mm transmitting a load of 985 kN and uniaxial bending moment of 49.25 kN.m. The SBC of soil 210 kN/m^2, use M20, Fe415. Design the symmetrical footing.	BT-4	Analyze
6.	Discuss about various types of combined footing with neat sketch.	BT-3	Application
7.	Write the step by step design procedure for rectangular combined footing.	BT-3	Application
8.	Write the step by step design procedure for strap footing.	BT-3	Application
9.	Discuss about various types of footing for RCC structures.	BT-3	Application
10.	Explain about proportioning of footings and foundations based on soil properties with suitable example.	BT-3	Application
11.	With near sketch, relate the critical sections for bending moment, one way shear and punching shear for an isolated footing.	BT-3	Application
12.	Tabulate the general design criteria to be considered regarding the selection of foundation based on soil condition?	BT-3	Application
13.	Proportion a rectangular combined footing for two columns 5 m apart. The exterior column of size 0.3 m x 0.3 m carries a load of 600 kN and interior	BT-4	Analyze

	column of size 0.4 m x 0.4 m carries a load of 900 kN. The allowable soil pressure is 100 kN/m^2.		
14.	Analyze the strap footing for two columns C1 and C2 carrying a load of 600 kN and 800 kN respectively. Size of the column is 400 X 400 mm and is spaced at a distance of 4 m centre to centre. The face of the column C1 is on the property line. The SBC soil is 200 kN/m^2. Use M20 and Fe 415 grades.	BT-4	Analyze
15.	Write the step by step design procedure for rectangular footing	BT-3	Application
16.	Design a rectangular isolated footing of uniform thickness for RC column of size 450 mm x 600 mm. carrying a load of 900 kN. Safe bearing capacity of soil is 200 kN/m^2. Use M 25 and Fe 415.	BT-4	Analyze
17.	Design a sloped square footing for a column of size 450 mm x 450 mm transmitting a load of 1450 kN. The column is reinforced with 4 # 20 and 4 # 25. Safe bearing capacity of the soil is 180kN/m^2. Use M 25 and Fe 415 grades of concrete and steel respectively.	BT-4	Analyze
18.	Design a strap footing for two column C$_1$ and C$_2$ 300 mm x 300 mm carries load of 600 kN and 850 kN, respectively spaced at 5m c/c. The column C$_1$ is on the property line. SBC of soil is 180 kN/m^2, use M20 grade concrete and Fe415 steel.	BT-4	Analyze